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CALCULATION PACKAGE COVER SHEET

Client: Gowanus Canal Remedial Design Group (RD Group) **Project:** Gowanus Canal Superfund Site **Project #:** HPH106A

TITLE OF PACKAGE: **TURNING BASIN 4 (TB4) PILOT STUDY DREDGE VOLUME ESTIMATES**

PREPARATION	**CALCULATION PREPARED BY:** (Calculation Preparer, CP)	Signature	Name Shaurya Sood	05/19/17 Date
REVIEW	**ASSUMPTIONS & PROCEDURES CHECKED BY:** (Assumptions & Procedures Checker, APC)	Signature	Name Mark W. Schillinger, P.E.	05/19/2017 Date
REVIEW	**COMPUTATIONS CHECKED BY:** (Computation Checker, CC)	Signature	Name Jeremy M. Gasser	5/19/17 Date
BACK-CHECK	**BACK-CHECKED BY:** (Calculation Preparer, CP)	Signature	Name Shaurya Sood	05/19/17 Date
APPROVAL	**APPROVED BY:** (Calculation Approver, CA)	Signature	Name J.F. Beech, Ph.D., P.E.	19 MAY 2017 Date

REVISION HISTORY:

NO.	DESCRIPTION	DATE	CP	APC	CC	CA
0	TB4 Pilot Study Design – Issued for Bid	05/19/2017	SS	MWS	JMG	JFB

4th STREET TURNING BASIN (TB4) PILOT STUDY DREDGE VOLUME ESTIMATES

INTRODUCTION

The remediation approach for the Gowanus Canal Superfund Site (Site), in accordance with the September 2013 Record of Decision (ROD) (United States Environmental Protection Agency [EPA], 2013) involves dredging the entire column of soft sediments that have accumulated in the Gowanus Canal (Canal). More specifically, the ROD states that the vertical extent of dredging is defined as the bottom of soft sediment, or the depth required to meet navigational requirements after the cap component of the remedy has been placed, whichever is deeper.

A comprehensive Pilot Study is being conducted in the 4th Street Turning Basin (TB4) to aid in the remedial design of the Gowanus Canal. The current phase of the Pilot Study will provide specific site information which will impact dredge operations and production, sediment processing, bulkhead supports and stability, and capping design.

To plan for dredging logistics and duration, as well as dredged material management operations for the Pilot Study, engineering estimates were performed to approximate the dredge volumes for four dredging sequences: (i) Access Dredging; (ii) Phase I – Dredging of Soft Sediment; (iii) Phase II – Dredging of Targeted Native Alluvial Removal Areas (TNARA); and (iv) Phase III – Dredging of Sediments beneath the 3rd Avenue Bridge. Additionally, the volume estimates for the Post-Dredging Backfill are included within this calculation package.

METHODOLOGY AND ASSUMPTIONS

AutoCAD Civil 3D (Civil 3D) was utilized to estimate the volumes for each of the dredge phases and the backfill. Civil 3D utilizes a digital terrain model to represent each surface of interest, where the surfaces are described as follows:

(i) **Bathymetry Surface:** The existing bathymetric surface (top of soft sediment) in TB4 Pilot Study area.

(ii) **Access Dredging:** A 40-foot wide channel is to be dredged to -8.57 feet (ft) North American Vertical Datum of 1988 (NAVD88) to allow access for vessels and barges into TB4 for completing bulkhead repairs and dredging.

(iii) **Phase I – Dredging of Soft Sediment:** The dredge surface to remove the soft sediment within the TB4 Pilot Study area. In some areas, this surface removes native alluvial material in order to obtain a relatively flat surface that can be dredged for cap placement.

(iv) **Phase II – Dredging of TNARA:** The dredge surface to remove four select areas of native alluvial material targeted for removal and described in the Statement of Work for the Pilot Study. In some areas, the stated dredge depth removes glacial deposits.

(v) **Phase III – Dredging of Sediments Beneath the 3rd Avenue Bridge:** The flat dredge surface to remove sediments from beneath the 3rd Avenue Bridge. Following a preliminary structural analysis of the bridge, this elevation was set at -4.5-ft NAVD88. A field investigation is currently being planned for the bridge and following the investigation, this surface and subsequent dredge volume is subject to change.

(vi) **Backfill of Selected Dredge Areas:** Surface presenting the areas of post-dredging backfill following dredging of Phase I and II within TB4 to provide a flat surface for placement of the cap. This surface was further split into four post-dredging areas: sand backfill, sand backfill during slotted excavation; low-permeable backfill during slotted excavation; and low-permeable backfill. These areas are presented in Figure 4 and detailed in the Construction Documents.

To estimate volumes between two surfaces, the composite volume method was used within Civil 3D. In this method, a composite surface was created by combining the triangulated irregular network (TIN) edges of the top and bottom surface (e.g., bathymetry of the Canal and access channel). Prismodial segments are then created from the composite TIN lines to calculate the volume between the two surfaces.

To visually show the thickness between the two surfaces, isopachs were created. These isopachs, contour lines of equal thickness, indicate the thickness of the material to be removed (or cut) from the base surface to reach the desired surface. Isopachs present the dredge face and volume for each phase to reach grade (the required dredge depth).

The Contract allows for 6 inches of overdredge allowance during access dredging, Phase I, Phase II, and Phase III. As stated in the Specifications, the Contractor is not required to remove the overdredge volume, but will be paid for the amount that they do remove. Dredging beyond the overdredge line will be considered excessive. The Contractor is responsible for all costs (i.e. removal, treatment, and disposal) associated with excessive dredging. During Backfill of Selected Dredge Areas, the Contract allows for an overfill of 3 inches. To calculate the overdredge or overfill, the three-dimensional area for each surface was calculated in Civil 3D and multiplied by

the specified overfill and overdredge allowance, respectively. Three-dimensional areas were carefully selected and modified to avoid double counting of areas (i.e. for the area where access dredging and Phase I overlap, no overdredge was calculated for the access dredging as that material was counted within Phase I). Overfill for the post-dredging sand backfill would be considered part of the leveling layer as both use the same material.

Source Information for Surfaces

Descriptions of how the bathymetry and subsurface stratigraphy were obtained in TB4 are described in the calculation package "Geologic Thickness Interface" provided as part of the 100% TB4 Pilot Study Design. The elevations for the dredge and backfill surfaces are provided as part of the 100% TB4 Pilot Study Design Construction Drawings:

- DR-3: Existing Bathymetry
- DR-5: Access Channel Dredging
- DR-6: Phase I – Dredging of Soft Sediment
- DR-7: Phase II – Dredging of Targeted Native Alluvial Removal Areas (TNARA)
- DR-8: Backfill of Selected Dredge Areas
- DR-11: Phase III – Removal of Sediments beneath the 3rd Avenue Bridge

Assumptions

- **Bathymetry** – The bathymetry is based on the multibeam hydrographic survey conducted by SeaVision Underwater Solutions, on 11 November 2016. Survey data represents conditions at the time of the survey and may not reflect current conditions. A third-party before-dredge (BD) survey, prior to commencement of dredging will determine final required and payable (required to grade plus overdredge allowance) dredge volumes.
- **Debris Volumes** – The Canal is known to have debris on top (see Construction Drawing DR-4) and buried within the sediment. The percentage of debris relative to the volume of sediment that will be removed is unknown, thus the dredging volumes presented within this calculation package include sediment and debris volumes.

- **Volume Measurement** – Volumes presented within this calculation package are presented as cubic yards (CY). It is assumed that this is 'in-place cubic yards', as shown in the hydrographic survey. The calculated dredge volumes do not account for shrinkage or swelling which may occur during dredging.

CALCULATIONS AND RESULTS

The volumes of dredge material and backfill of selected dredge areas in the TB4 Pilot Study area are provided in Tables 1 and 2. A total required volume of 20,921 CY is estimated to be dredge. Of the required volume, approximately 2,658 CY is Access Dredging, 15,431 CY is Phase I - Soft Sediment, 2,434 CY is Phase II – TNARA, and 398 CY is Phase III – 3rd Avenue Bridge. The volume of post-dredging sand backfill is estimated to be 64 CY, 501 CY for sand backfill during slotted excavation, 1,959 CY for low-permeable backfill during slotted excavation, and 562 CY for low-permeable backfill.

The total overdredge volume in the TB4 Pilot Study area is estimated at 1,017 CY. Of the overdredge volume, approximately 120 CY is Access Dredging, 481 CY is Phase I - Soft Sediment, 361 CY is Phase II – TNARA, and 55 CY is Phase III – 3rd Avenue Bridge. Overfill volume for the allowable three inches during post-dredging backfill is 27 CY for sand backfill, 40 CY for sand backfill during slotted excavation, 125 CY for low-permeable backfill during slotted excavation, and 66 CY for low-permeable backfill. A hand (manual) calculation for overdredge volumes is provided as Attachment A.

In addition to volume calculations, backchecks were performed to confirm the volumes and isopachs generated by Civil 3D. Five points (A through E) were selected in the TB4 Pilot Study area for quality control verification. The locations of these points are specified in Table 3. The elevations of points A through E on drawing DR-3 were compared to their respective elevations on the access channel dredging surface (Drawing DR-5) from the 100% TB4 Pilot Study Design Construction Drawings. The difference in elevation between the bathymetry and access channel dredging surfaces for these five points were then compared to their respective elevation differences on the access channel vs bathymetry isopach (Figure 1). The same process was used to check the accuracy of dredge volumes associated with Phase I - Soft Sediment, Phase II – Targeted Native Alluvial Removal Areas, Phase III – Sediments Beneath the 3rd Avenue Bridge and Backfill of Selected Dredge Areas.

As an example, the dredge thickness calculation for Point B was performed as follows:

- Elevation of point B: Bathymetry Surface = - 6 ft

- Elevation of point B: Access Channel Surface = - 8.57 ft
- Elevation of point B: Phase I – Soft Sediment = - 15.8 ft
- Elevation of point B: Phase II – Targeted Native Alluvial Removal Areas = - 20.2 ft
- Elevation of point B: Backfill of Selected Dredge Areas = - 15 ft
- Calculated thickness of Access Dredging Surface = - 6 ft – (- 8.57 ft) = 2.57 ft
- Isopach contour for Access Channel (vs) Bathymetry = 2 - 3 ft (cut)
- Calculated thickness of Phase I – Soft Sediment Surface = - 8.57 ft - (-15.8 ft) = 7.23 ft
- Isopach contour for Soft Sediment (vs) Access Channel and Bathymetry = 6-8 ft (cut)
- Calculated thickness of Phase II – Targeted Native Alluvial Removal Areas = - 15.8 ft – (-20.2 ft) = 4.4 ft
- Isopach contour for Native Alluvial (vs) Soft Sediment = 4-5 ft (cut)
- Calculated thickness of Backfill Surface = - 15 ft – (-20.2 ft) = 5.2 ft
- Isopach contour for Backfill (vs) Soft Sediment and Native Alluvial = 5-6 ft (cut)

Table 3 provides a summary for all comparisons.

SUMMARY AND CONCLUSIONS

The dredge volume estimates were performed within Civil 3D by comparing the bathymetry, access channel, Phase I, Phase II, Phase III, and Backfill of Selected Dredge Areas surfaces to create respective isopachs and composite volumes. Backchecks were completed to confirm the accuracy of the Civil 3D calculation. The total required dredge volume for the Pilot Study (access channel, Phase I, Phase II, and Phase III) is 20,921 CY, with a total payable volume of 21,938 CY. Total required post-dredging backfill volume for the Backfill of Selected Dredge Areas is 3,086 CY, with a total payable backfill of 3,344 CY.

REFERENCES

Palermo, M.R. *Construction and Navigation Tolerances for Cap Design*. White Paper Document. 2015.

United States Environmental Protection Agency (EPA), September 2013. "Record of Decision, Gowanus Canal Superfund Site, Brooklyn, King County, New York."

TABLES

Table 1. Summary of Dredge Volumes by Phase for TB4 Pilot Study

Description	Required Volume to Grade (CY)(6)	Overdredge Volume (CY)(7)	Total Payable Volume (CY)(8)
Access Channel (CY)(1)	2,658	120	2,778
Phase I – Soft Sediment (CY)(2)	15,431	481	15,912
Phase II - TNARA (CY)(3)	2,434	361	2,795
Phase III – 3rd Ave Bridge (CY)(4)	398	55	453
Total Dredge Volume (CY)(5)	20,921	1,017	21,938

Notes:

1. Access channel dredge volume is calculated by comparing the bathymetry surface with the access channel dredging surface.
2. Phase I – Dredging of Soft Sediment dredge volume is calculated by running a composite comparison of the bathymetry and access channel dredge surface with the Phase I dredge surface.
3. Phase II – TNARA dredge volume is calculated by running a composite comparison of the Phase I dredge surface with the Phase II dredge surface.
4. Phase III – Dredging of Sediments Beneath the 3rd Avenue Bridge dredge volume is calculated by running a composite comparison of the estimated bathymetry under the 3rd Avenue Bridge with the flat dredge elevation of -4.5 ft NAVD88.
5. Total dredge volume is the summation of the dredge surface volumes described above.
6. Required Volume to Grade is the volume required to reach dredge grades the Contractor must obtain to complete the phase of dredging.
7. The overdredge allowance is volume the Contractor will get paid to remove, but is not required to remove. For the access channel, Phase I, Phase II, and Phase III the overdredge allowance is 6 inches. The overdredge volumes were calculated as the product of three-dimensional (3-D) area of dredge surface (subtracting the overlapping two-dimensional area of the dredge surface below to avoid double counting volumes) by the overdredge allowance of 6 inches. The 3-D areas used to estimate the overdredge volumes for the Access Channel, Phase I, Phase II, and Phase III were 6,497, 25,947, 19,497, and 2,962 sf, respectively. For example, overdredge for the access channel was only calculated for the areas of Phase I dredging not below the access channel dredging.
8. Total Payable Volume is the maximum volume the Contractor will get paid to remove. It is the summation of the required volume to grade and the overdredge allowance.

Table 2. Summary of Volumes for Backfill of Selected Dredge Areas in TB4 Pilot Study

Description	Required Volume to Grade (CY)	Overfill Volume (CY)[2]	Total Volume (CY)
Post-Dredging Sand Backfill (CY)[1]	64	27	91
Post-Dredging Sand Backfill during Slotted Excavation (CY)[1]	501	40	541
Post-Dredging Low-Permeable Backfill during Slotted Excavation (CY)[1]	1,959	125	2,084
Post-Dredging Low-Permeable Backfill (CY)[1]	562	66	628
Total Backfill Volume (CY)	3,086	258	3,344

Notes:

1. The volumes for post-dredging backfill are calculated by running a composite comparison of the Backfill of Selected Areas with the Phase I and Phase II surfaces. The volumes are presented in Figure 4.
2. Overfill Volume was calculated as the product of the 3-D area of Selected Dredge Areas with Backfill and the overfill allowance (3 inches).

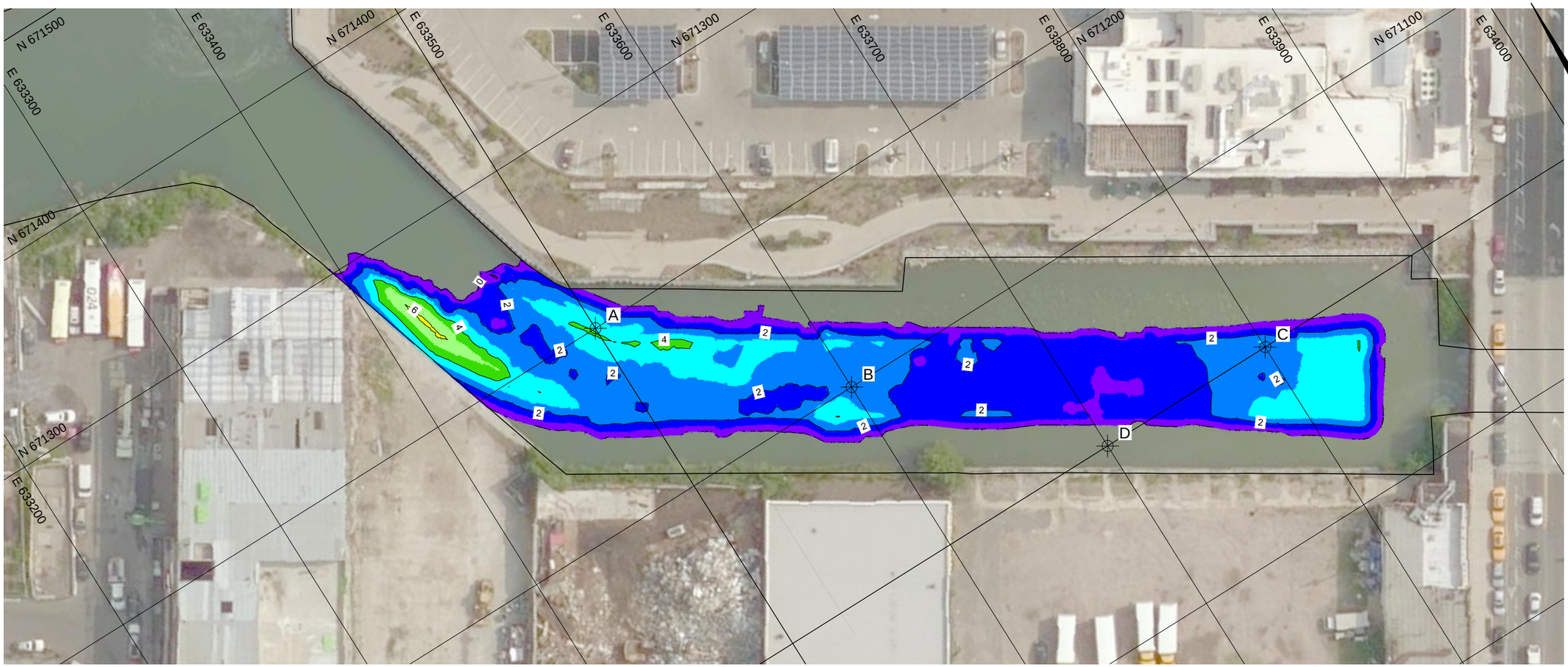
Table 3. Summary of the Elevations of Points A through E for the Verification of Dredge Volumes

Surface	Figure or Drawing Number	TB4 Pilot Study Area				
		Point A(1)	**Point B(1)**	**Point C(1)**	**Point D(1)**	**Point E(1)**
Bathymetry	DR-3	- 3.75 ft.	- 6 ft.	-5.75 ft.	- 7 ft.	0.42 ft.
Access Channel Dredging	DR-5	- 7.5 ft.	- 8.57 ft.	- 8.57 ft.	-	-
Phase I: Soft Sediment	DR-6	- 15.5 ft.	- 15.8 ft.	- 17 ft.	-16 ft.	-
Phase II: Targeted Native Alluvial Removal Areas (TNARA)	DR-7	-	-20.2 ft.	-	-19.5 ft.	-
Phase III –3rd Avenue Bridge Dredge	DR-11	-	-	-	-	-4.5 ft.
Backfill of Selected Dredge Areas Surface	DR-8	-15 ft.	-15 ft.	-16 ft.	-16 ft.	-
Calculated Thickness of Access Channel Dredging	DR-3 and DR-5	3.75 ft.	2.57 ft.	2.82 ft.	-	-
Access Channel Dredging Thickness from Isopach	Figure 1	3 – 4 ft.	2 – 3 ft.	2 – 3 ft.	-	-
Calculated Thickness of Phase I: Soft Sediment	DR-5 and DR-6	8 ft.	7.23 ft.	8.43 ft.	9 ft.	-
Phase I: Soft Sediment Thickness from Isopach	Figure 2	8 ft.	6 – 8 ft.	8 – 10 ft.	8 –10 ft.	-
Calculated Thickness of Phase II: Targeted Native Alluvial Removal Areas	DR-6 and DR-7	-	4.4 ft.	-	3.5 ft.	-
Phase II: Targeted Native Alluvial Removal Areas Thickness from Isopach	Figure 3	-	4 – 5 ft.	-	3 – 4 ft.	-
Calculated Thickness of Phase III –3rd Avenue Bridge Dredge	DR-3 and DR-11	-	-	-	-	4.92 ft.
Phase III –3rd Avenue Bridge Dredge Thickness from Isopach	Figure 5	-	-	-	-	4 – 5 ft.
Calculated Thickness of Backfill for Selected Dredge Areas	DR-8	0.5 ft.	5.2 ft.	1 ft.	3.5 ft.	-
Thickness of Backfill for Selected Dredge Areas from Isopach	Figure 4	0.5 – 1 ft.	5 – 6 ft.	0.5 – 1 ft.	3 – 4 ft.	-

Notes:

1. Points A, B, C, D and E are located at the intersections of N 671200 & E 633500, N 671100 & E 633600, N 671000 & E 633800, N 671000 & E 633700 and N670900 & E 633900, respectively.

FIGURES



ELEVATION TABLE		
COLOR	MINIMUM ELEVATION	MAXIMUM ELEVATION
	0	1
	1	2
	2	3
	3	4
	4	5
	5	6
	6	7
	7	8
	8	9
	9	10

TB4 - ISOPACH
COMPARISON SURFACE: BATHYMETRY
BASE SURFACE: ACCESS CHANNEL DREDGE
VOLUME: 2,658 CY

NOTES:

1. THE HORIZONTAL COORDINATE VALUES PROVIDED ON THIS FIGURE ARE BASED UPON THE NORTH AMERICAN DATUM OF 1983 (NAD83), NEW YORK STATE EAST ZONE.
2. ELEVATIONS PROVIDED ON THIS FIGURE ARE BASED ON THE NORTH AMERICAN VERTICAL DATUM OF 1988 (NAVD88), NEW YORK STATE EAST ZONE.
3. CONTOURS SHOWN ON THIS FIGURE ARE IN 2-FT INTERVALS.

LEGEND

10 — ISOPACH ELEVATIONS (FT)

CANAL BOUNDARY

0 60' 120'

SCALE IN FEET

TB4 - ISOPACH
ACCESS CHANNEL VS BATHYMETRY
GOWANUS CANAL SUPERFUND SITE
BROOKLYN, NEW YORK

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FIGURE 1

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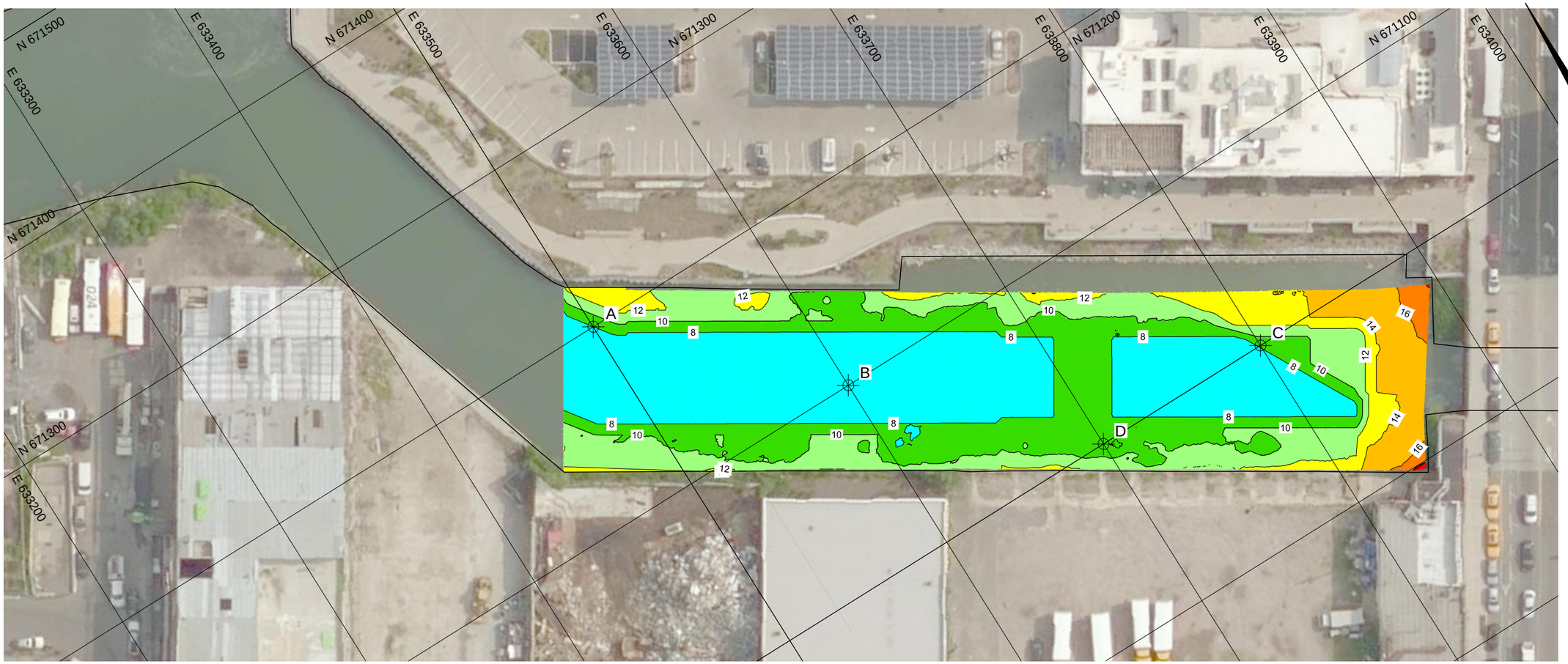

ELEVATION TABLE		
COLOR	MINIMUM ELEVATION	MAXIMUM ELEVATION
	0	2
	2	4
	4	6
	6	8
	8	10
	10	12
	12	14
	14	16
	16	18
	18	20

TB4 - ISOPACH
COMPARISON SURFACE: ACCESS CHANNEL DREDGE AND BATHYMETRY
BASE SURFACE: PHASE I - SOFT SEDIMENT
VOLUME: 15,431 CY

NOTES:

1. THE HORIZONTAL COORDINATE VALUES PROVIDED ON THIS FIGURE ARE BASED UPON THE NORTH AMERICAN DATUM OF 1983 (NAD83), NEW YORK STATE EAST ZONE.
2. ELEVATIONS PROVIDED ON THIS FIGURE ARE BASED ON THE NORTH AMERICAN VERTICAL DATUM OF 1988 (NAVD88), NEW YORK STATE EAST ZONE.
3. CONTOURS SHOWN ON THIS FIGURE ARE IN 2-FT INTERVALS.

LEGEND

10 — ISOPACH ELEVATIONS (FT)

CANAL BOUNDARY

0 60' 120'

SCALE IN FEET

TB4 - ISOPACH
ACCESS CHANNEL AND BATHYMETRY VS
PHASE I - SOFTS SEDIMENT
GOWANUS CANAL SUPERFUND SITE
BROOKLYN, NEW YORK

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FIGURE 2

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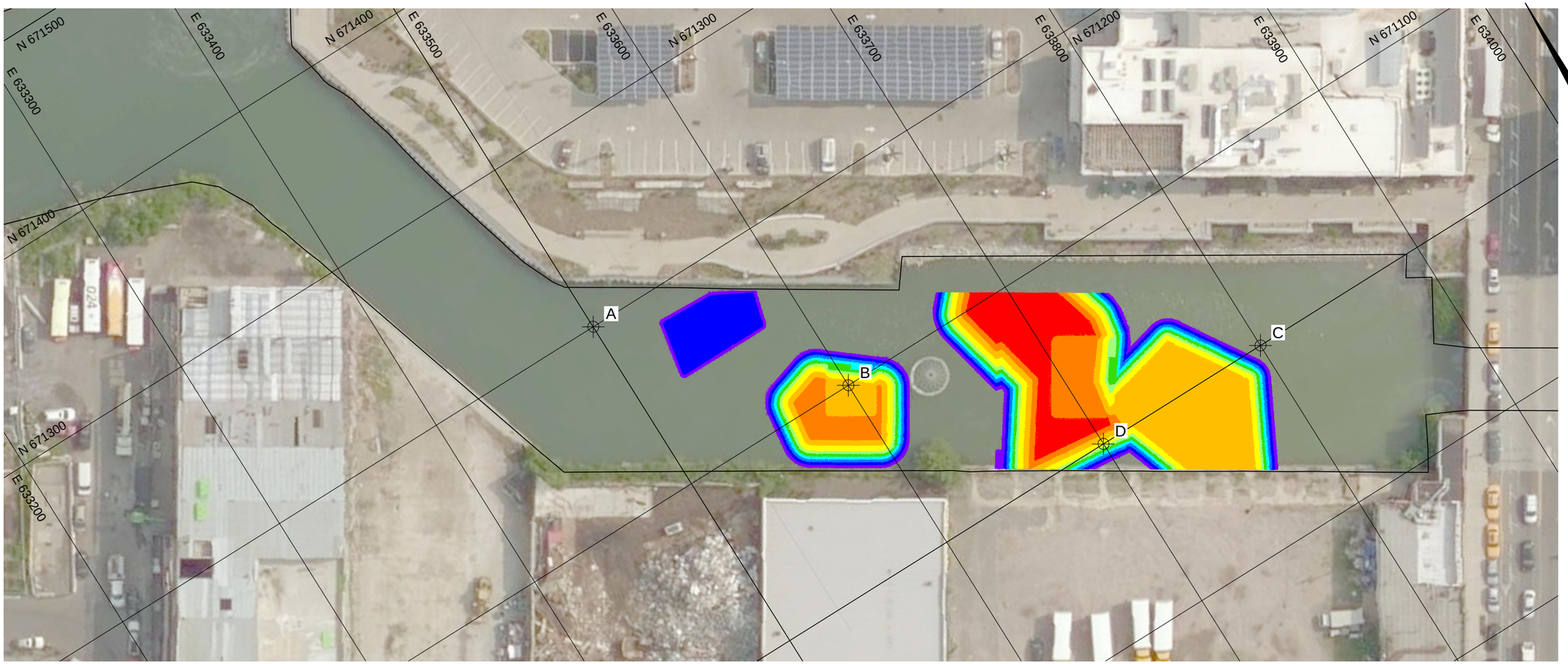

ELEVATION TABLE		
COLOR	MINIMUM ELEVATION	MAXIMUM ELEVATION
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	1.0	1.5
	1.5	2.0
	2.0	2.5
	2.5	3.0
	3.0	4.0
	4.0	5.0
	5.0	6.0
	6.0	7.0

TB4 - ISOPACH
COMPARISON SURFACE: PHASE I - SOFT SEDIMENT
BASE SURFACE: PHASE II - TNARA
VOLUME: 2,434 CY

NOTES:

1. THE HORIZONTAL COORDINATE VALUES PROVIDED ON THIS FIGURE ARE BASED UPON THE NORTH AMERICAN DATUM OF 1983 (NAD83), NEW YORK STATE EAST ZONE.
2. ELEVATIONS PROVIDED ON THIS FIGURE ARE BASED ON THE NORTH AMERICAN VERTICAL DATUM OF 1988 (NAVD88), NEW YORK STATE EAST ZONE.
3. CONTOURS SHOWN ON THIS FIGURE ARE IN 2-FT INTERVALS.

LEGEND

10 — ISOPACH ELEVATIONS (FT)

CANAL BOUNDARY

0 60' 120'

SCALE IN FEET

TB4 - ISOPACH
PHASE I - SOFT SEDIMENT VS
PHASE II - (TNARA)
GOWANUS CANAL SUPERFUND SITE
BROOKLYN, NEW YORK

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FIGURE 3

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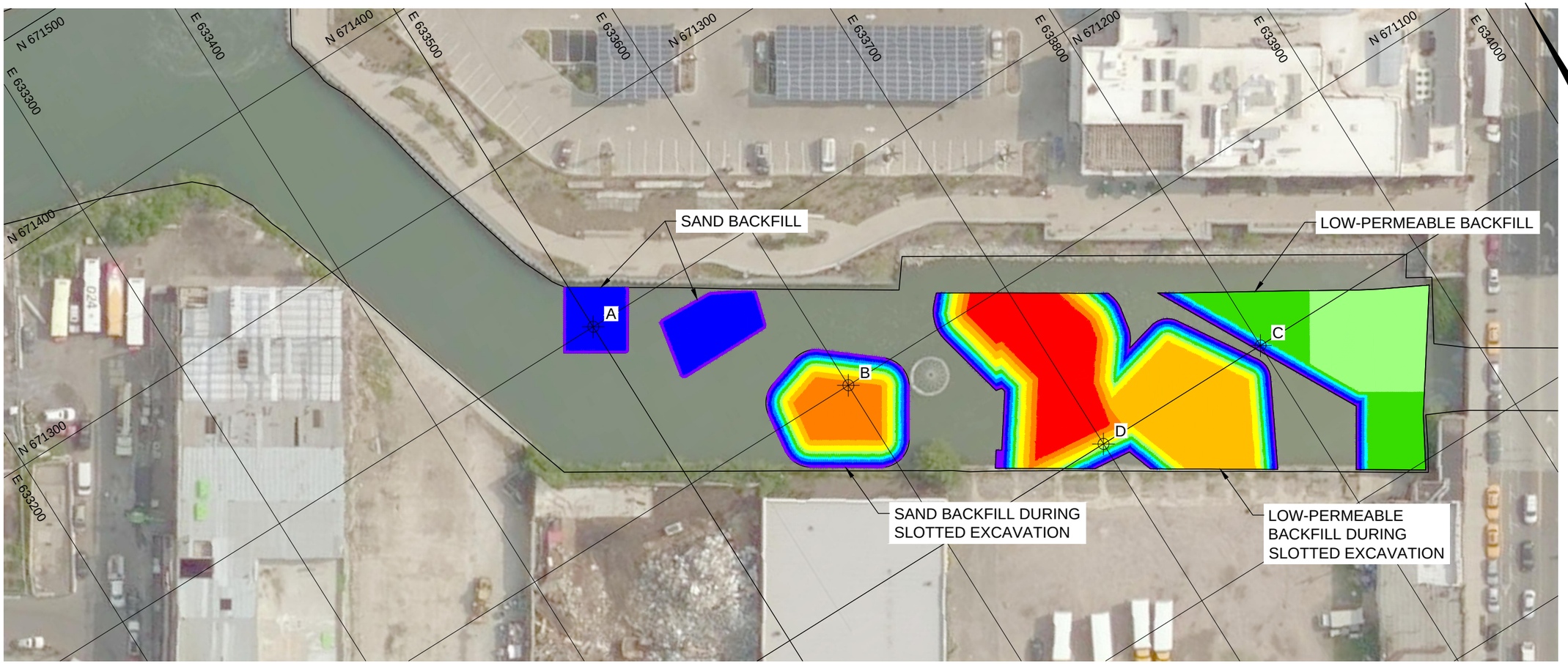

ELEVATION TABLE		
COLOR	MINIMUM ELEVATION	MAXIMUM ELEVATION
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	1.0	1.5
	1.5	2.0
	2.0	2.5
	2.5	3.0
	3.0	4.0
	4.0	5.0
	5.0	6.0
	6.0	7.0

TB4 - ISOPACH
COMPARISON SURFACE: BACKFILL SURFACE
BASE SURFACE: SAND BACKFILL
VOLUME: 64 CY

TB4 - ISOPACH
COMPARISON SURFACE: BACKFILL SURFACE
BASE SURFACE: SAND BACKFILL DURING SLOTTED EXCAVATION
VOLUME: 501 CY

TB4 - ISOPACH
COMPARISON SURFACE: BACKFILL SURFACE
BASE SURFACE: LOW PERMEABLE BACKFILL DURING SLOTTED EXCAVATION
VOLUME: 1,959 CY

TB4 - ISOPACH
COMPARISON SURFACE: BACKFILL SURFACE
BASE SURFACE: LOW PERMEABLE BACKFILL
VOLUME: 562 CY

LEGEND

1 — ISOPACH ELEVATIONS (FT)

CANAL BOUNDARY

0 60' 120'

SCALE IN FEET

NOTES:

1. THE HORIZONTAL COORDINATE VALUES PROVIDED ON THIS FIGURE ARE BASED UPON THE NORTH AMERICAN DATUM OF 1983 (NAD83), NEW YORK STATE EAST ZONE.
2. ELEVATIONS PROVIDED ON THIS FIGURE ARE BASED ON THE NORTH AMERICAN VERTICAL DATUM OF 1988 (NAVD88), NEW YORK STATE EAST ZONE.
3. CONTOURS SHOWN ON THIS FIGURE ARE IN 2-FT INTERVALS.

TB4 - ISOPACH
BACKFILL SURFACE VS PHASE I - SOFT SEDIMENT AND PHASE II - TNARA AND LOW-PEREMEABLE FILL
GOWANUS CANAL SUPERFUND SITE
BROOKLYN, NEW YORK

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FIGURE 4

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ELEVATION TABLE		
COLOR	MINIMUM ELEVATION	MAXIMUM ELEVATION
	0	1
	1	2
	2	3
	3	4
	4	5
	5	6
	6	7
	7	8
	8	9
	9	10

TB4 - ISOPACH
COMPARISON SURFACE: BATHYMETRY
BASE SURFACE: 3RD AVE BRIDGE DREDGE
VOLUME: 398 CY

NOTES:

1. THE HORIZONTAL COORDINATE VALUES PROVIDED ON THIS FIGURE ARE BASED UPON THE NORTH AMERICAN DATUM OF 1983 (NAD83), NEW YORK STATE EAST ZONE.
2. ELEVATIONS PROVIDED ON THIS FIGURE ARE BASED ON THE NORTH AMERICAN VERTICAL DATUM OF 1988 (NAVD88), NEW YORK STATE EAST ZONE.
3. CONTOURS SHOWN ON THIS FIGURE ARE IN 2-FT INTERVALS.

LEGEND

10 — ISOPACH ELEVATIONS (FT)

CANAL BOUNDARY

0 30' 60'

SCALE IN FEET

TB4 - ISOPACH
3RD AVENUE BRIDAGE DREDGE VS BATHYMETRY
GOWANUS CANAL SUPERFUND SITE
BROOKLYN, NEW YORK

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FIGURE 5

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ATTACHMENT A

Page 1 of 2

Geosyntec consultants

Written by SHAURYA GOOD Date 26/04/17 Reviewed by Jenny Gaines Date 26/04/17

Client: RD GROUP Project: GOWANUS CANAL Project/Proposal No. HPH106A Task No. 52.02

Overdredge Volume Calculations

(I) Access Channel

The overdredge volume is the product of 3-D area of the section of access channel dredge surface located outside the limits of TB4 Pilot Study area (to avoid double counting the overdredge with Phase I) and overdredge allowance (6 inches)

Overdredge Volume = $(6,497 \times 0.5)\ ft^3 = 3248.5\ ft^3$

$\simeq$ 120 ICY (in-place cubic yards)

(II) Phase I : Soft Sediment

The overdredge volume was calculated as the product of the difference of the 3-D area for Phase I : Soft Sediment and 2-D area of Phase I : TNARA and overdredge allowance.

Overdredge Volume = $(44,942 - 18,995) \times 0.5\ ft^3$

$= 12,973.5\ ft^3 \simeq 481$ ICY

(III) Phase II : TNARA (Targeted Native Alluvial Removal Areas)

The overdredge volume was calculated as the product of the 3-D area for Phase II : TNARA and overdredge allowance

Overdredge Volume = $(19,497 \times 0.5)\ ft^3$

$= 9748.5\ ft^3 \simeq 361$ ICY

(IV) Phase III : Sediments Beneath 3rd Avenue Bridge

The overdredge volume was calculated as the product of the 3-D area for Phase III : 3rd Avenue Bridge and overdredge allowance

Overdredge Volume = $(2,962 \times 0.5)\ ft^3$

$= 1481\ ft^3 \simeq 55$ ICY

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Geosyntec consultants

Written by: SHAURYA SOOD Date: 18/05/17 (DD MM YY) Reviewed by: MATTHEW SCHECHINGER Date: 19/05/17 (DD MM YY)

Client: RD Group Project: Gowanus Canal Project/Proposal No.: HPH106A Task No.: 52.02

(V) Overfill of Selected Dredge Areas with Backfill

For the backfill of selected dredge areas, the additional overfill volume was calculated as the product of 3-D backfill dredge surface area and 3" overfill allowance.

(A) Sand Backfill

Overfill Volume = (1,240 + 1,654) x 0.25 ft^3

= 723.5 ft^3 ≃ 27 ICY

(B) Sand Backfill during Slotted Excavation

Overfill Volume = (4,300 x 0.25) ft^3

= 1075 ft^3 ≃ 40 ICY

(C) Low - Permeable Backfill during Slotted Excavation

Overfill Volume = (13,484 x 0.25) ft^3

= 3371 ft^3 ≃ 125 ICY

(D) Low - Permeable Backfill

Overfill Volume = (7,108 x 0.25) ft^3

= 1777 ft^3 ≃ 66 ICY